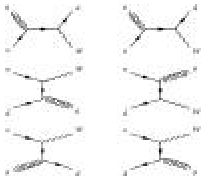
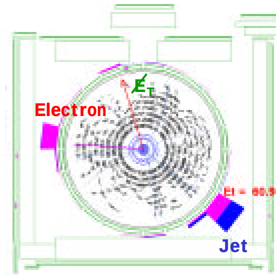
Test of enhanced leading order QCD in W plus jets events from 2 TeV $p\bar{p}$ collisions

1. Introduction



he production of W bosons in $p\bar{p}$ collisions t the Fermilab Tevatron collider provides he opportunity to test perturbative QCD t large momentum transfers.
sample of 31,726 W candidates collected rom 72 pb^{-1} of accumulated data is used to tudy the kinematic properties and the pro- uction rates of high energy hadronic jets association with W bosons.
he jets are the manifestation of high-energy partons (quarks and uons) after the hard collision. The figure shows some of the leading- rder processes which produce a W boson and a jet.
he electroweak decay W -> eν of the W boson gives an efficient lentification of W candidates with low background contamination. This hannel provides sufficient statistics to study the QCD production haracteristics for W + = 0 to = 4 jets event samples.
esides the relevance of testing perturbative QCD al large momentum ransfers, these processes are among the preeminent search channels in ery high energy particle collisions. Within the Standard Model (SM), he top quark was discovered and its mass measured in the W + = 3 jets ith at least one jet identified as a b-jet. The W + 2 jets, with both ets identified as b-jet, is used to search for the Higgs boson and single op production. The W + jets channels is also relevant in many SM xtensions which predict new particles decaying into W boson ccompanied by jets.
recise understanding of the W + n jets channels is then particularly nportant for many high-P_T physics analyses.

2. Event Selection



Luminosity : 72 pb^{-1} (Mar.2002 ~ Jan.2003)

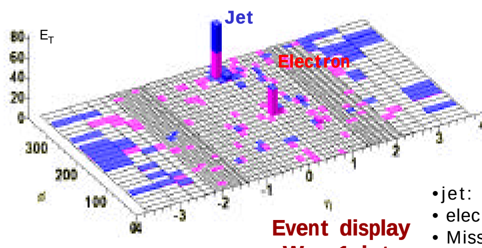
Trigger Path : High E_T Electron Trigger, E_T > 18 GeV

Kinematic : Ele E_T > 20 GeV, P_T > 10 GeV; $\not{E}_T$ > 30 GeV

Geometric : |?| < 1.1 & well instrumented region

Identification : Had/Em < 0.055, E/P < 2, Isolation < 0.1, tower-track matching, shower profile, conversion veto

W candidates : 31,726 events



Event display
W + 1 jet

Jet Selection

Cone jet algorithm (JETCLU)
Jet fully corrected:
- relative & absolute energy scale
- out of cone & underlying event

E_T > 15 GeV ,|?| < 2.4, R_{cone} = 0.4

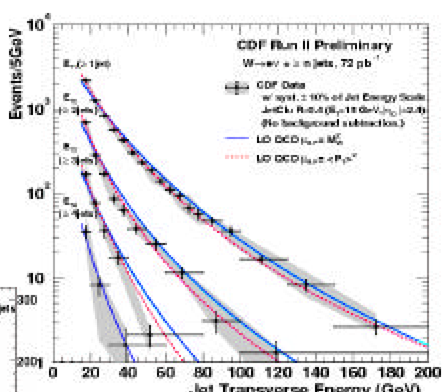
- jet: E_T = 91GeV, ? = 0.1 , f = 5.54
- electron E_T = 31.8 GeV, ? = 0.45 , f = 3.07
- Missing E_T E_T = 53 GeV, f = 1.94
- W transverse mass = 87.2 GeV

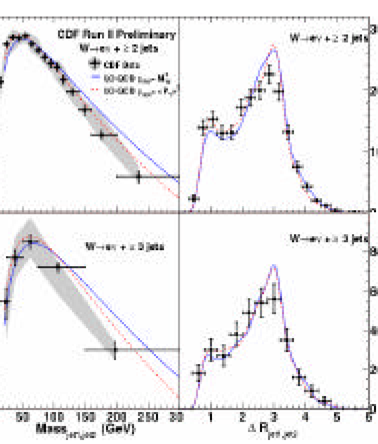
3. Kinematic Distributions

Theory:
- GR@PPA & ALPGEN LO calculation interfaced with the HERWIG shower Monte Carlo
- full detector simulation to include efficiency and acceptance effects
- theory distributions normalized to the total number of events in the data and fitted with n analytic function
- two different renormalization scales: M_W^2 (static), $\langle P_T\rangle^2$ (dynamic)

Jet E_t Distribution

he highest E_T jet in W + = 1 jet
he second highest E_T jet in W + = 2 jets
he third highest E_T jet in W + = 3 jets
he fourth highest E_T jet in W + = 4 jets





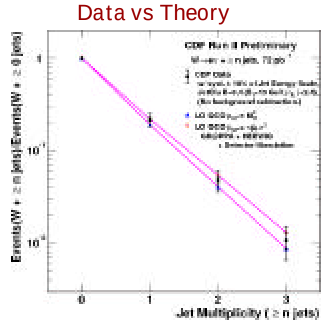
Dijet Mass and ?R Distributions

The plots on the left show the distribution for the invariant mass of the two highest E_T jets in W + = 2 jet events (top), and W + = 3 jet (bottom). The plots on the right show the separation in *?-f* space for the same jets used on the left side distributions.

4. Fraction of Jets

Parton – Jet Matching:
- defined as "each jet generated by one and only one parton"
- reduced dependence on the generation cuts: P_T & ? R
- partial reduction of the "double counting problem"

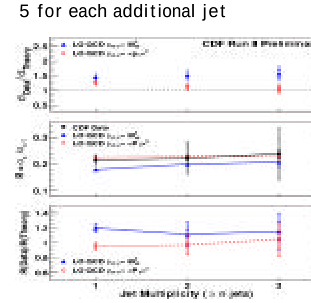
Data vs Theory



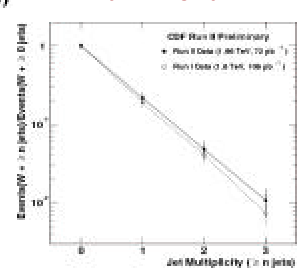
Good agreement data and theory

Ratio of Jet Multiplicity

- some systematics cancel out
- data/theory ~ constant
- n/n-1 ~ 0.2 ⇨ s drops by a factor 5 for each additional jet



Run II vs Run I



Run II higher jets activity

5. Conclusion

- The LO QCD predictions have been compared to CDF Run II Data
- Theory well reproduce the kinematic behavior of W + = n jet
- The large q² dependence indicates the importance of high order corrections

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